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Constant Output Under Transient Condition in Wind Turbine using Novel Boost Converter

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Abstract: The performance of the wind turbine, is highly dependent on the power of wind. Regarding environmental conditions in India constant flow of wind is unexpected. During soft-start in wind turbine, fluctuation has occurred, and due to the change of wind flow, the rotational speed is changed. At the same time, the output voltage of generator connected to the turbine is directly proportional. Due to the fluctuation of the air flow, the output voltage is disrupted, so it is important to increase the voltage and maintain a constant speed. DC-DC boost converter are particularly useful for a better match of voltage to supply. In base paper DC generator is used now in this work Synchronous generator is used with proposed boost converter and obtain the output. With this switching and amplify the voltage higher than the conventional converter at the same frequency and in the same work cycle. Here, as the output will be used in the variable voltage state of the wind turbine. The simulation model generates and outputs are obtained using Matlab Simulink.

Keywords: Wind turbine, snubber capacitor, DC to DC Boost converter, Matlab Simu

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I. INTRODUCTION

Energy consumption in the last century has considerably increased due to massive industrialization. The energy need forecast for the coming years conform this trend. On the one hand, the traditional energy resources of fossil origin has been exploited for several decades, which suggests a situation shortage of energy globally which will be coming up. On the other hand, nuclear waste creates further problems in terms of pollution of radioactive waste. To meet the energy needs of today's society, it is necessary to expand them with new solution. Alternative energy resources such as solar and wind have attracted energy sources to generate power on a large scale. However, common drawback with solar and wind energy are unpredictable. They depend on weather and climatic changes. Standalone photovoltaic (PV) or wind energy systems are not possible to generate energy for considerable portion of time during the entire period of the day. In order to efficiently and economically utilize the renewable energy resources, one optimum match design technique is needed and to use the power even in the various situation of transient period. In this proposed paper the optimized boost converter is introduced with minimum switching losses and minimum ripple factor in the output voltage across the load. High-Power dc/dc converter is a vital component of today's emerging vehicular technologies, such as battery-electric, wind solar hybrid-electric, fuel cell electrical apparatus. Usually, a voltage boost is required to step up the low voltage of the wind generator, fuel cell or battery to the high voltage required by the traction motor inverter or constant voltage dc loads. In these applications, it is essential that the size and mass of the converter are reduced. Furthermore, the converter should feature a simple design with high-efficiency operation over the entire load range. In addition to emerging traction systems, dc/dc boost converters find applications in micro turbine-based wind power generation systems, two-stage photovoltaic systems, and power factor correction schemes for single-phase diode rectifier circuits. The huge passive components used in high-power dc/dc boost converters, particularly huge inductor, encompass a major part of the size of the converter. It helps to reduce the size of the passive components by operating in the high frequency. So that through this high specific power, high power density can be obtained and by this fast transient response can also be achieved. However, there are two important types to have high-frequency operation for high-power (up to 10-kW) dc/dc converters. First, the switching losses increase proportionally with the increased frequency, which reduces converter efficiency and increases cooling requirements. A larger cooling system adds to the overall cost and mass of the converter system. Second, and most problematically, the high power insulated-gate bipolar transistors (IGBTs) used in these converters are commonly limited to hard-switching operation at about 30 kHz [I] or less, depending on the power level. The switching frequency limit exists to prevent overheating and failure of the IGBT. If soft switching is used, the switching losses become reduced, enabling these IGBTs to operate at frequencies up to 70 kHz [1], which can extensively reduce the size of passive components in the converter without increasing the size of the heat sink. Thus, a suitable soft switching circuit should be employed in high-power boost converters for traction applications so that switching frequency can be increased, passive components masses can be reduced, and high specific power objectives can be met. In recent years, a number of circuits and control techniques have been proposed to reduce

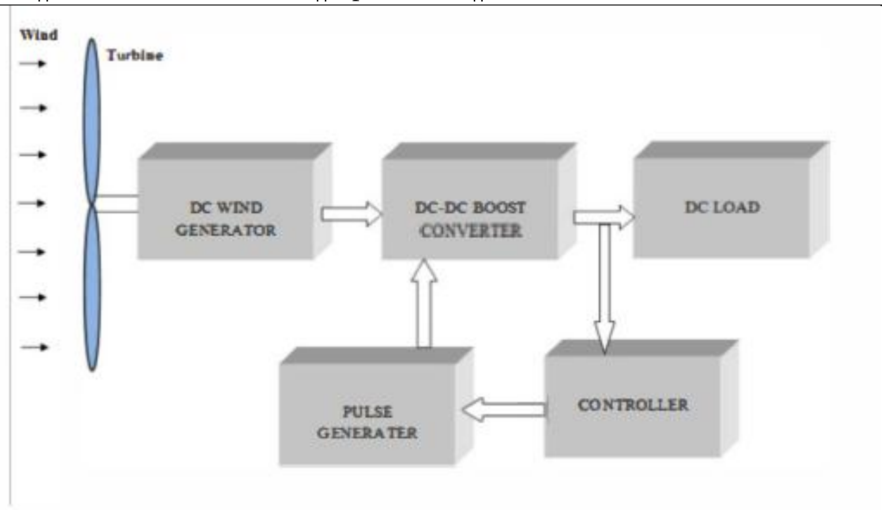


Fig 1.1 Proposed Wind generator with novel boost converter

The switching losses in dc/dc boost converters. In resonant and quasi-resonant converters, the devices are turned-off and/or-on at zero voltage or zero current of a resonant mode [2], [3]. However, resonant converters require careful matching of the operating frequency to the re sonant tank component values, and operation failure can occur in the case of any magnetic saturation or unexpected drift in re sonant frequency. Also, it is difficult to design filters and control circuits because of the wide range of switching frequency variations. Furthermore, the addition of one or more high-power inductors for the resonant circuit, which can have significant mass due to the high current rating required, can partially or fully offset the benefit of using a higher switching frequency (i.e., increasing the specific power of the converter). Passive soft-switching methods [4]-[10] use only passive components to achieve zero-voltage or zero-current switching at a constant switching frequency. The auxiliary circuits can be complicated and require numerous extra components, including extra inductors, which can again partially or fully offset the mass reduction benefits of using a higher switching frequency. Also, many of the proposed passive methods are designed for low-power boost converters using metal oxide field effect transistors (MOSFETs) and hence focus on reducing the reverse-recovery losses (due to the boost diode) during turn-on of the switch rather than the more significant turn-off los ses found in high-power converters using IGBTs. It is noteworthy that new silicon carbide (SiC) diodes have nearly zero reverse-recovery current and can be implemented.

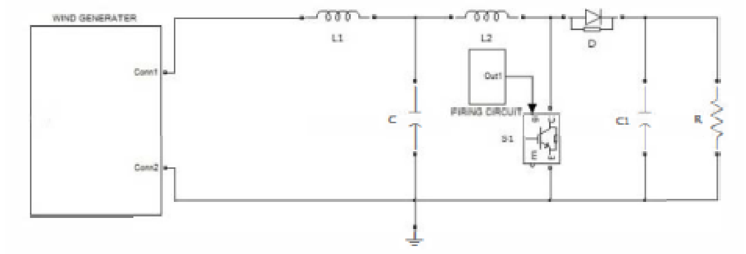
II. PROPOSED WIND SYSTEM STRUCTURE

A schematic diagram of a stand-alone wind system is shown in Fig. l. Wind generator is directly connected with the boost converter without connecting the batteries. Boost converter is used to boost the voltage during the transient period as weil as when the wind force low to maintain the voltage across the load or inverter to be constant. It is connected between the wind generator and load.Controller is connected across the output voltage to generate respective command to pulse generator in order to maintain

The voltage to be constant during transient period. Pulse generator is connected with the output from the control section and to generate respective width of the pulses. These pulses are triggering the switching devices of the converter. Normally the switching losses play a major role in converters.But in this proposed novel boost converter using the snubber capacitor the switching losses reduced significantly

III. PROPOSED WIND GENERATOR MODEL

The wind speed distributions for selected sites as well as the power output characteristic of the chosen wind turbine are the factors that have to be considered to determine the wind energy conversion system power output. Choosing a suitable model is very important for wind turbine power output simulations. The most simplified model to simulate the power output of a wind turbine . The wind speed distributions for selected sites as well as the power output characteristic of the chosen wind turbine are the factors that have to be considered to determine the windenergy conversion system power output. Choosing a suitable model is very important for wind turbine power output simulations. The most simplified model to simulate the power output of a wind turbine can be described by [12].Where PR is the rated electrical power; V c is the cut-in wind speed ;V R is the rated wind speed; and V F is the cut-off wind speed. In this study, the adjustment of the wind profile for height is taken into account by using the power law that has been recognized as a useful tool to model the vertical profile of wind speed. The equation can be formulated as in Where V(H) is the wind speed at hub height H, m/s; V(Hre□ is the wind speed measured at the reference height Hfe!, m/s; pis the power law exponent. The determination of p becomes very important. The value of 1/7 is usually taken when there is no specific site data .



Conventional hard switched boost Converter

IV. PROPOSED CONVERTER STRUCTURE

The conventional boost converter circuit diagram is shown in Fig.2. This circuit is designed with the input and output filter. Mainly the input filter is to maintain the constant current and the output filter to maintain the constant voltage across the load. For comparing the output with the proposed converter both the converter are designed to operate in the frequency of 30KHz.The working principle of it is constant frequency with variable turn-on and turn-off method. During the turn on of the main switch S j the inductor is charging the power and discharging it with the source power during the turn off of the switch SjThe proposed novel boost soft switched converter is shown in Fig.3.

Proposed soft switched boost Converter

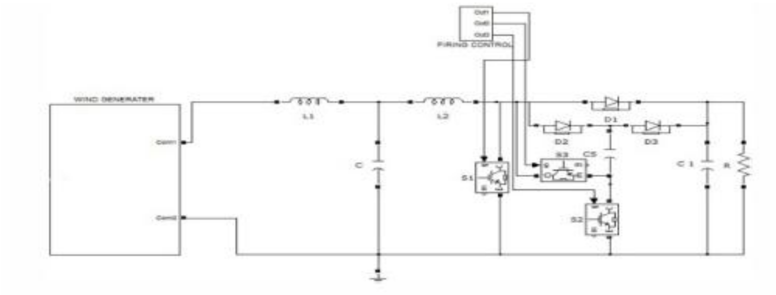


Fig 2 Working of the proposed converter

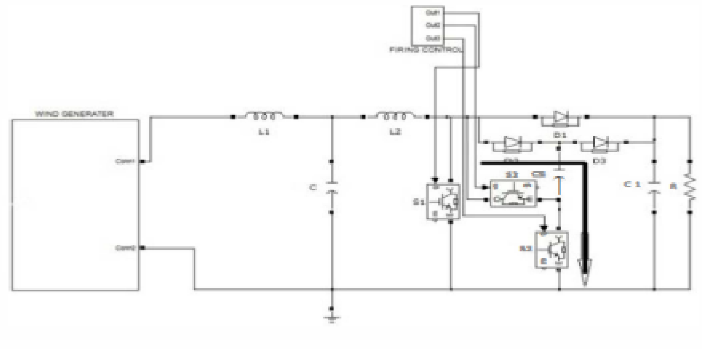


Fig. 3.Operation of the Snubber Circuit during the first turn OFF of the switch S1

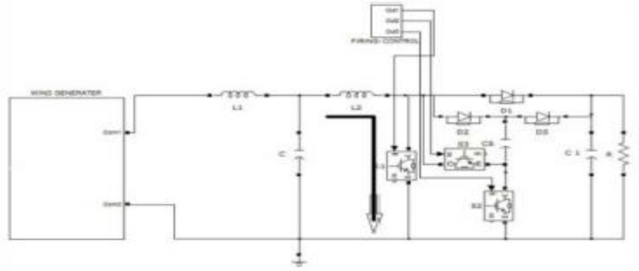


Fig.3 Operation of the Snubber Circuit during the Switch S1 is ON

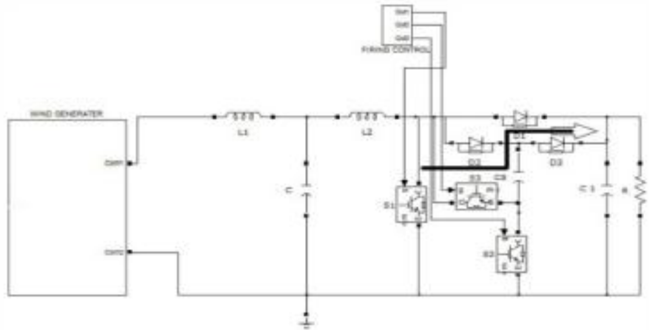


Fig.4.Operation of the Snubber Circuit during the second turn OFF of the switch S1

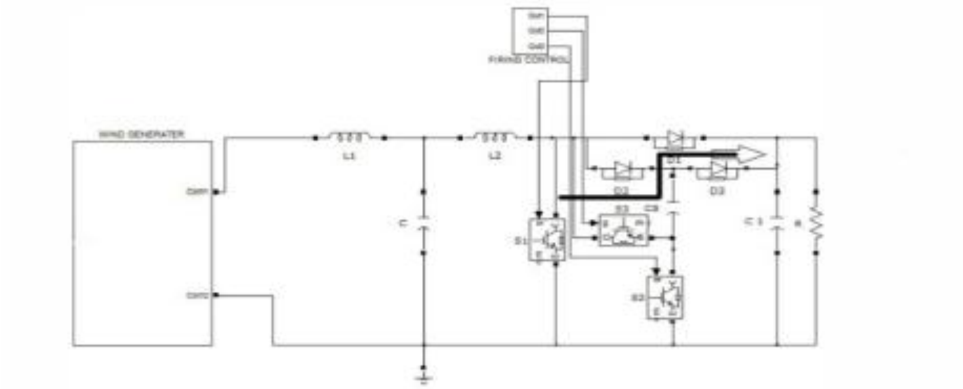
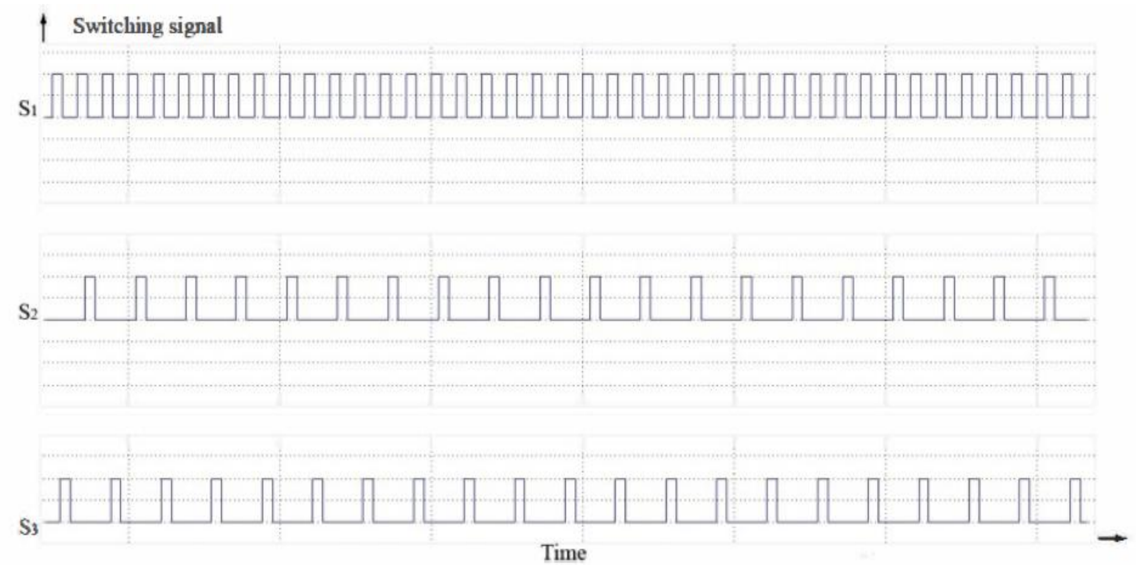


Fig.5.Operation of the Snubber Circuit during the second turn OFF of the switch S1

In high power IGBT- based boost converters, the switching losses generally very high during turn- off time than turn- on. The huge loss across the IGBT can be shown by the curren wave form following the rapid rise of the voltage across the switch during turn off. The turn-on loss however, can be significantly reduced by reducing or eliminating the reverserecovery current of the boost diode. This can now be easily achieved by using silicon carbide (SiC) diodes, since they exhibit virtually zero reverse-recovery current . Thus, the proposed capacitor-switched regenerative-snubber circuit focuses on reducing the significant turn-off losses in high power boost converters so that high switching frequencies can be achieved. Along with it less ripple output voltage also produced across the load. The operation of the hard switched method the output of the wind generator has been connected direct1y to the converter to boost the voltages during transient period as well as voItage sag. During the turn on of the switch S, the inductor L2 charging the current where inductor LI and capacitor C are acting as the current filter. When the switch S, turn of the input voltage added with the inductor voItage and delivered to the load through diode D,.At the load side the capacitor C, is connected to reduce the ripple factor and to maintain the constant voltage across the load. The proposed soft switch converter is shown in Fig.3.But in our proposed convertor the main idea is to charge the snubber capacitor Cs at one turn off of the main switch SI and discharging it in the next turn off of the main switch S,.through this operation the voltage rise across the switch, and current pulse rise are reduced. To realize the operation of the proposed converter, the snubber capacitor with the main switch reversed for every turn off of the switch S, to charge this from 0 to V;:",I and vice versa.

B. Worhng ofthe proposed converter

At the first turn off of the switch Sl' shown in FigA, the auxiliary switch S3 turn on at the 75 percentage of the pulse turn on in the Sl'this is to reduce the switching loss in the auxiliary switch S3. Now even the switch SI turn off S3 continuously turn on up to its desired pulse width, and to charge the snubber capacitor from 0 to Vout. This charging action reduces the voltage rice across the switch Sl'and greatly reduces the loss while current in SI falls quickly. During the next turn on of S 1, both S2 and S, in off position so the snubber _ circuit does not affect the operation of SI.At the same time when S, is on, the charged voltage (Vout) in the snubber circuit will not discharge through diode D3 and the body diode of the S, because the voltage at anode of D, and cathode of D, are same shown in Fig.5. Then at the next turn off of the switch Sl' the switch S2 turn on and S, turn off, the energy stored in the snubber capacitor is being discharged through S2 and diode D3 shown in Fig.6. This action gradually getting slowdown, now voltage across the switch SI gradually increased, so the current tail in the SI reduced. Total energy stored in the snubber capacitor is discharged to the output, leading the very good operation. When both the switch Sz and S3 are turning off the operation of the circuit during SI on as hard switched one. The only loss in the converter by the snubber circuit is the short pulses of conduction losses in the auxiliary diodes. The auxiliary switches do not add further conduction losses compared to the hard switched converter because auxiliary IGBTs supplement the ON time of the main switch SIThus the proposed snubber circuit boost converter switch SI ON time is lesser than the ON time of the hard switch technique to reach the same voltage. Also, due to the nature of the circuit, both auxiliary switches operate with zero-voltage turn on and zero-voltage and zero-current turn-off; thus, virtually no switching losses are introduced [15]. Effectively, the current is commutated from the main switch (where a turn-off event would generate large losses due to the voltage rise across the switch) to an auxiliary switch, which has a zero-voltage and zero-current turn-off. Overall, the additional conduction losses in the auxiliary diodes are small in comparison with the reduction in the losses of the main switch at turn-off.



MATLAB SOFTWARE OUTPUT WITHOUT FEED BACK

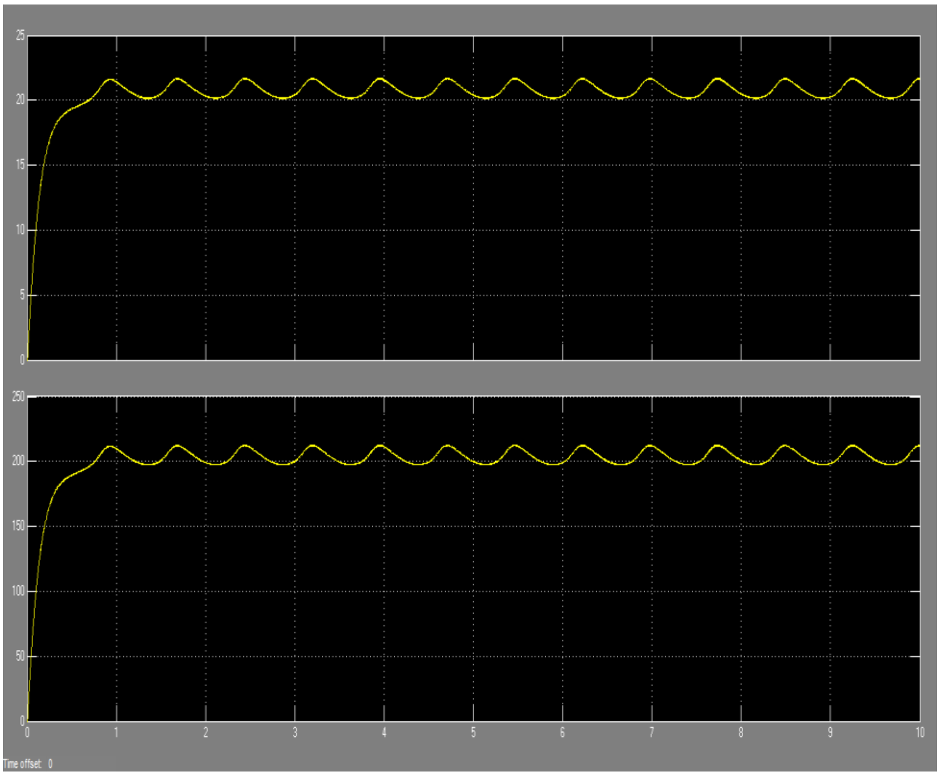


Fig 1: Simulation Output without Feedback

MATLAB SOFTWARE OUTPUT WITH FEED BACK

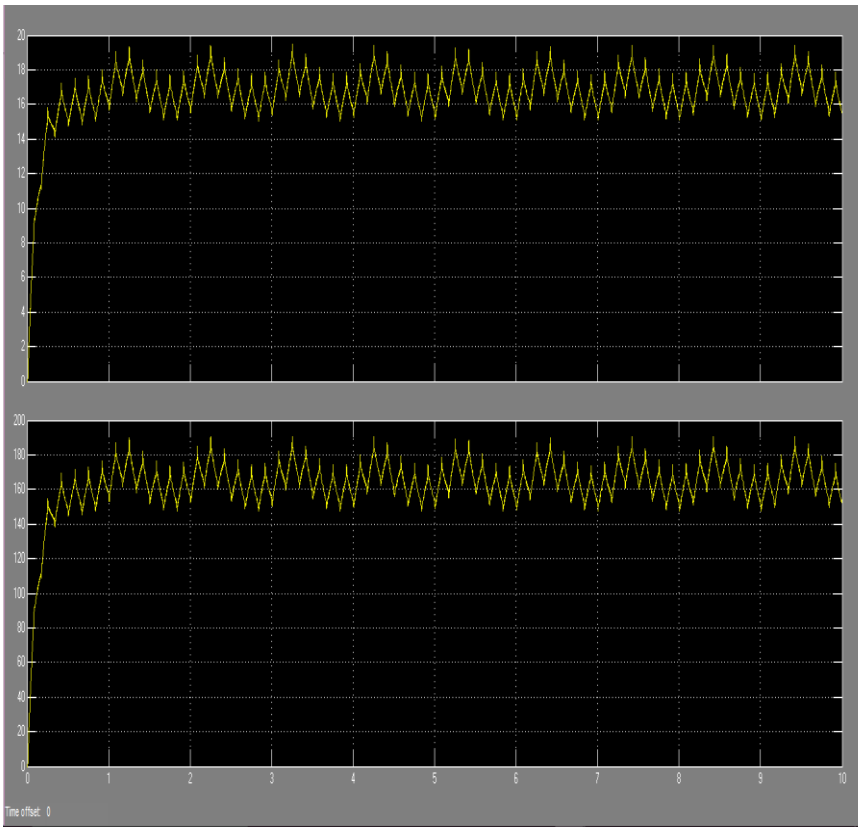


Fig 2: Simulation Output with Feedback

V. CONCLUSION AND FUTURE SCOPE

CONCLUSION

This proposed research work focused a design consideration of the different parameters, an improved control strategy, and very good experimental results. Unlike many soft switched converter presented in the literature survey they need large inductors and switching circuit, the only additional circuit required in this proposed converter are two switches , two diodes, and one snubber capacitor. In this converter IOBTs are used for the control switches because they are very sensitive for the high power application. The operating frequency of it is assigned by 30KH for both conventional and proposed method. By this novel technique, the switching losses are reduced and obtained high voltage. Due to the simple design, control technique, and better efficiency it is well suited for applications like Wind generators, Battery vehicle, and Photovoltaic cells. Apart from that the proposed converter is identified as highly suited for DC Wind turbine system to enable, the control of current in to a constant load, as well as in to grid.

FUTURE SCOPE

Future and development of India depends upon many factors: one of them is being self dependent for its energy demands. It will free India from its dependency on other countries for nuclear energy generation. Although Government's plans look ambitious now but it certainly aims to be self-reliant. Of all the major renewable sources they are primarily focusing on wind (generation and distribution). But, there are some limitations with implementation of this technology that must be considered. Wind turbines cannot be set up in many of the unused areas because it requires a huge amount of capital investment. Therefore, cost of wind turbines should be less so that they can be easily planted in more areas. Many research and development centers should be opened for the further enhancement and progress of wind power. Subject regarding to wind power technology and other renewable energy technologies must be introduced in colleges and schools which may increase its scope in future tremendously. In India, metros network can be a great source of wind power generation as it will need lighter equipment than conventional wind turbines to harness the wind generated by commute of metro trains. In some cities metro rails are already running and in several other cities government is planning to run it. So, lighter wind turbines can be installed at sites of the metro tracks so without much extra investment wind energy can be generated.

REFERENCES

[1]. Jennifer Bauman, Mehrdad, "A Novel Capacitor-Swiched Regenerative Snubber OCIDC Boost Converters" IEEE Tran.Ind. Electron., vol. 58, no.2, pp. 514-523, Feb. 2011.

[2]. Y.-c. Chuang and Y.-L. Ke, "High-efficiency and low-stress ZVTPWM OC-to-OC converter for battery charger," IEEE Trans. Ind. Electron.,vol. 55, no. 8, pp. 3030-3037, Aug. 2008.

[3]. J.-M. Kwon, W.-Y. Choi, and B.-H. Kwon, "Single-switch quasiResonant converter," IEEE Trans. Ind. Electron., vol. 56, no. 4, pp.1158-1163, Apr. 2009.

[4]. M. R. Amini and H. Farzanehfard, "Novel family of PWM softsingle switched OC-OC converters with coupled inductors," IEEE Trans. Ind. Electron., vol. 56, no. 6, pp. 2108-2114, Jun. 2009.

[5]. E. S. da Silva, L. dos Reis Barbosa, J. B. Vieira, L. C. de Freitas, and V. 1. Farias, "An improved boost PWM soft-single-switched converter with low voltage and current stresses," IEEE Trans. Ind. Electron., vol. 48, no. 6, pp. 1174-1179, Dec. 2001.

[6]. OD D. C. Lu, D. K. W. Cheng, and Y.-S. Lee, "A single-switch continuous conduction-mode boost converter with reduced reverse recovery and switching losses," IEEE Trans. Ind. Electron., vol. 50, no. 4, pp. 767-776, Aug. 2003

[7]. J. L. Russi, M. L. S. Martins, and H. L. Hey, "Coupled-filter inductor soft-switching techniques: Principles and topologies," IEEE Trans. Ind.Electron., vol. 55, no. 9, pp. 3361-3373, Sep. 2008.

[8]. F. L. Tofoli, E. A. A. Coelho, L. C. de Freitas, V. J. Farias, and J.B. Vieira, "Proposal of a soft-switching single-phase three-level rectifier," IEEE Trans. Ind. Electron., vol. 55, no. 19, pp. 107-113, Jan.2008.

[9]. Y. C. Chuang and Y. L. Ke, "High-efliciency and low-stress ZVTPWM OC-to-OC converter for battery charger," IEEE Trans. Ind. Electron., vol. 55, no. 8, pp. 3030-3037, Aug. 2008.

[10]. [10] B.-R. Lin, c.-L. Huang, and 1.-F. Wan, "Analysis, design, and Implementation of a parallel ZVS converter," IEEE Trans. Ind. Electron., vol. 55, no. 4, pp. 1586--1594, Apr. 2008.

[11]. M. M. Hernando, A. Fernandez, 1. Garcia, O. G. Lamar, and M. Rascon, "Comparing Si and SiC diode performance in commercial AC-to-DC rectifiers with power-factor correction," IEEE Trans. Ind. Electron., vol. 53, no. 2, pp. 705-707, Apr. 2006.

[12]. Pallabazzer R. Evaluation ofwind generator potentiality. Solar Energy, 1995 ;55:49-59. [13] Ilinka A, McCarthy E, Chaumel JL, RNiveau JL. Wind potential assessment of Quebec Province. Renewable Energy 2003;28(12): 1881-97.

[13]. Mostafaeipour A. Feasibility study of harnessing wind energy for turbine installation in province of Yazd in Iran. Renewable Sustainable Energy Rev. 2010;14(4):93-111.

[14]. QCJ. Marshall and M. Kazerani, "A novel lossless snubber for boost converters," in Proc. IEEE Int. Symp. Ind. Electron.,Montreal, Canada, Jul. 9-13, 2006, pp. 1030—1035.